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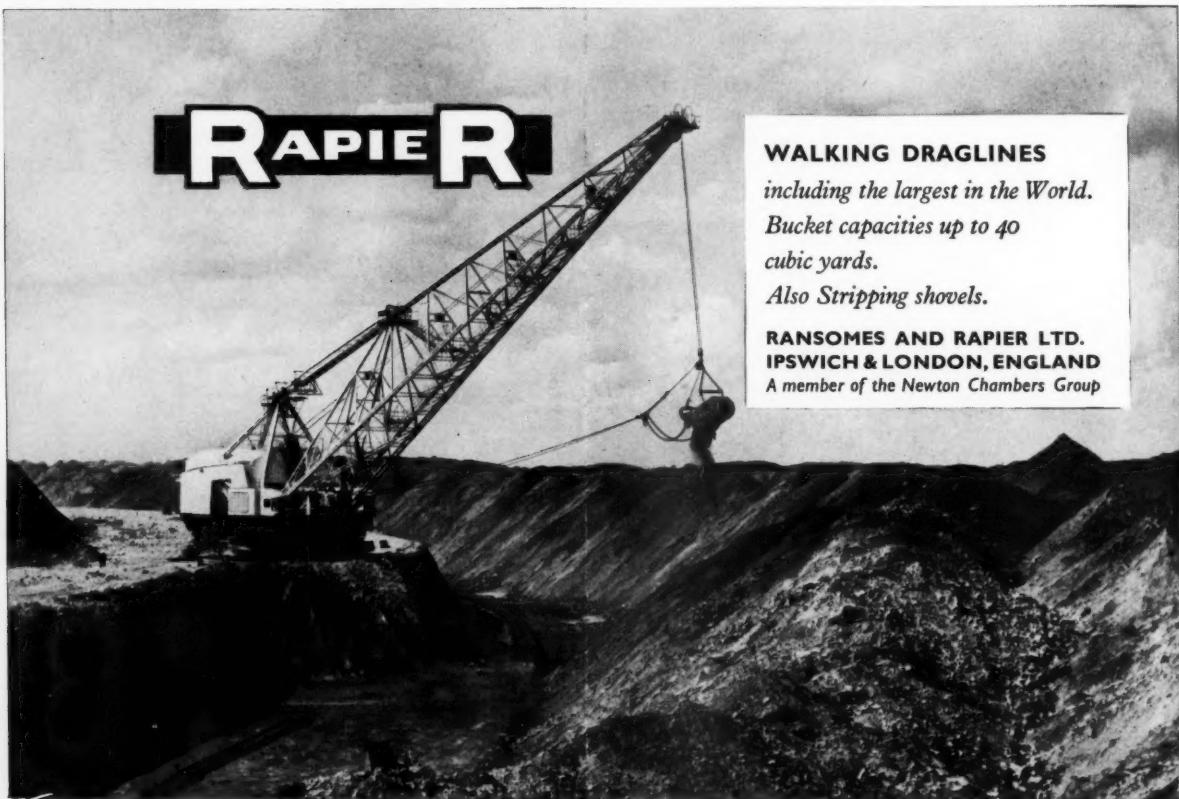
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The Mining Journal

London, September 11, 1959

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Reading Confusion into the Tin Agreement

AT its quarterly meeting, held in London last week, the International Tin Council decided to raise the permissible export tonnage for producer member countries during the last quarter of this year to 30,000 tons compared with 25,000 tons, 23,000 tons and 20,000 tons for the third, second and first quarters of the year respectively. This latest increase is equivalent to an increase of 20,000 tons in a full year and approximates to the amount by which Free World consumption is currently estimated to be running in excess of Free World production plus expected Iron Curtain exports. If production and consumption are to be held in balance, it may be assumed that the buffer stock has now reached an optimum level such as will give the buffer stock manager maximum room for manoeuvre either as a buyer or a seller as future market fluctuations dictate.

In this connection a certain amount of muddled thinking has been in evidence during the past week which the I.T.C. has deliberately, and in our view mistakenly, refrained from dissipating. Article VII of the Tin Agreement provides that export control shall not become effective unless at least 10,000 tons of tin is held in the buffer stock or unless in the view of the Council this level seems likely to be reached during the next control period. *The Mining Journal* (and, so we had supposed, the tin market itself) has always regarded this provision as relating solely to the circumstances pre-requisite to the initial introduction of export control, but suggestions have recently appeared in the Press that this could be taken to mean that export control would at no time be operative if buffer stocks were below 10,000 tons.

If there were any substance in this view it could become a factor of fairly immediate practical importance as, if prices are to be kept steady, the buffer stock manager, who has been a heavy seller over recent weeks and may not now be holding more than 12,000 - 13,000 tons, will presumably have to continue to sell until the higher quota for the fourth quarter begins to become effective. Common sense, however, suggests that this is most unlikely to be the interpretation which the I.T.C. places on Article VII.

In the first place, any sudden suspension of export control would, even on the basis of the newly announced quota level, probably result not only in current production going up by a minimum of seven or eight thousand tons a quarter but would also enable producers' permitted stocks (which under the agreement can, and in many cases probably do, stand at 25% of exports) being put on the market. Any such sharp fluctuation in supplies is obviously contrary to the intention of the Tin Agreement, which has always been that quota adjustments should take care of the long term imbalance between supply and demand, leaving the buffer stock to provide the more delicate instrument for short term adjustment.

We have always supposed that once export control came into operation it would remain in force for the duration of this and subsequent Tin Agreements. Certainly, in the event of any temporary shortage of tin, it would be administratively very much simpler to continue to raise quota levels rather than to do away with controls

which would almost certainly have to be reimposed, as any sudden flood of metal would again quickly bring the buffer stock above 10,000 tons.

Moreover, if the intention of Article VII had indeed been that quotas should cease whenever the buffer stock fell below 10,000 tons, one would have expected to see a considerably larger increase in quotas in the third (current) period, as in such a situation the buffer stock manager's optimum holding of metal would need to be higher by some 5,000 tons than if he were free to run his stocks right down.

With tin, the problem has usually been how to turn the tap off soon enough rather than how to boost supplies, and the one notable postwar exception to this experience during the period of hectic American stockpiling merely serves to remind us that in any future time of shortage there is over 300,000 tons of tin in the American stockpile, which in the present climate of Washington thinking is far less likely to remain immobilized than in the past. In effect, therefore, any interpretation of Article VII which assumes the cessation of export control with a buffer stock at under 10,000 tons must also assume that the buffer stock manager is operating within minimum and maximum stock limits of 10,000 and about 23,000 tons respectively and that the producers have capital tied up in the first 10,000 tons which is serving no useful purpose. It seems most unlikely that they would have agreed to such an arrangement!

One consequence of the confusion over Article VII has been that attention has also been focused on Section 1 of Article XI relating to the liquidation of the buffer stock. This paragraph provides that during the last two years of the currency of the Tin Agreement, the Council "when fixing the total permissible export amount for any control period in accordance with the provisions of Article VII, shall pay due regard to the need for reducing the quantity of tin metal held in the buffer stock by the date of termination of this Agreement", and the Council is empowered to reduce export quotas accordingly.

The point about this paragraph surely is that it is permissive rather than mandatory in intent and it seems most unlikely that the I.T.C. would wish to avail itself of these powers unless there was serious doubt regarding the renewal of the Agreement, which is due to go through various stages of renegotiation between now and next May. Not only are there at the moment no indications to suggest that the Agreement will not be renewed, but had the Council been contemplating a deliberate running down of the buffer stock, it seems highly unlikely that the fourth quarter's quota would have been increased to the extent that it has.

A point which may however be worth noticing about this paragraph is that it does place the Council in the position, over the last two years of the present Agreement, of being able to give certain formal directives to the buffer stock manager, which hitherto it may not have been empowered to give, as, taken in isolation, Article IX, which deals with the management and operation of the buffer stock, places upon the buffer stock manager sole responsibility regarding its operation and the level at which it shall be maintained, subject to his absolute compulsion to buy and sell outside of the floor and ceiling prices.

MINING EXPANSION IN AUSTRALIA

Three Northern Territory authorities, the Director of Mines, the Assistant Administrator of the Territory and the manager of Territory Enterprises Ltd., which company operates the Rum Jungle uranium mine and is a subsidiary of Consolidated Zinc Ltd. (which in turn works the mine for the Commonwealth Government), are of opinion that there will be early development of large mineral lodes in

the northern part of the Territory. Although mining at Rum Jungle has ceased, about six years' supply of uranium ore is stockpiled at the mine and will keep the mill running over that period. There is, however, a further prospect here, and plans are in hand for the exploitation of a large silver-lead occurrence below the worked-out uranium ore bodies. It was predicted that in the foreseeable future up to 500 tons of silver-lead ore per day, would be railed to Darwin, for shipment.

Bauxite deposits in north-western Arnhem Land are reported as being very large. Consolidated Zinc holds an option over the bauxite area which w.l. probably be developed in conjunction with the Weipa bauxite field.

Considerable attention has recently been given to the search for iron ore to meet the increasing demands for steel in Australia. A recent report advises the discovery of a large deposit near the mouth of the Roper River, which is estimated to contain 100,000,000 tons of ore of unspecified grade. There is also reported an occurrence of low grade tin ore close to the Darwin-Larrimah railway, and about 100 miles from Darwin. Attention to large mineral occurrences would direct attention to the numerous small ore deposits in the Territory, which might lead to larger discoveries, or form workable groups of properties. Work over the last few years has shown that this hitherto neglected region has an important mineral future and can be regarded as one of the major metalliferous provinces of Australia.

The State Government of Tasmania still plans for a State-owned steel industry and is carrying on drilling of iron ore occurrences with that object. The most promising is in the Savage River country in the north-west of the Island. Drilling has been carried to a depth of 940 ft. and has been suspended for the present. Several bores have been completed but although the government is optimistic, there is opinion that the tonnage of ore indicated is inadequate to warrant the expenditure that would be involved. Further test work has shown that the grade of the ore is not high enough for direct smelting and that beneficiation would be a necessary step. The Mines Department plant is being moved to Long Plains, which is held under lease by Rio Tinto Australian Exploration Ltd. and where an occurrence of iron ore was located by aerial survey. More boring on the Savage River deposit is to be carried out before a decision is made as to its commercial value. The region is rugged and difficult of access.

The famous Mount Bischoff tin deposit, which in its day was the largest and richest tin occurrence in the world, is to be re-examined. The Tasmanian Government has given approval to Rio Tinto to explore the old mine. All shallow tin orebodies have been, long since, worked out, so work will be directed to exploration for deep-seated occurrences; a percussion drill is to be used. After the old company closed down, the Commonwealth and State Governments, in conjunction, carried out exploratory work, but without success.

The Rosebery Mines of Electrolytic Zinc Co. of Australasia Ltd., seem assured of a long future. Extensions of lode indicated by geological work, have been fully confirmed by underground development. Output was steadily increased until the world zinc-lead position necessitated curtailment of production. Meantime, an extensive modernization programme has been carried out and has considerably increased the company's productive capacity, of which advantage will not be taken at present, but which will be immediately available as soon as the metal market justifies it. The increased productive capacity is about 25 per cent, or some 50,000 tons of ore per year. Present output is approximately 200,000 tons of ore per year, the metal content of which is predominantly zinc. The zinc concentrate is consigned by rail and ship to the Risdon works. A new hoist is being placed at the underlay shaft, to raise ore

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NEW ZEALAND SHALE OIL AND IRON SANDS DEVELOPMENTS

With practically no overburden, approximately 2,000,000,000 tons of oil-bearing shale which could be worked by opencast mining methods are claimed to lie in the 20-mile long Nevis Valley, Central Otago, South Island, the development of which could provide New Zealand with a sizeable part of its oil requirements.

A considerable amount of exploratory work on these reserves has been done by the Otago Development Council and some months ago the council sent about 1 cwt. of Nevis shale samples, selected by the University of Otago School of Mines, to the Union Oil Co. of California in the United States for testing. As a result of the tests, Union Oil thought that it should be possible to construct a plant designed to handle this shale.

Since then, the Prime Minister of New Zealand, Mr. Walter Nash, at the request of the Otago Development Council, has interviewed the vice-president of Union Oil, Mr. Fred L. Hartley, in San Francisco. The latter advised the council to get into touch with the Swedish oil shale concerns to obtain a clear picture of the situation.

Nevis is in an inaccessible part of Otago and has a severe climate. Furthermore, the oil content of the shale is not high. It is thought possible, however, that with opencast methods, the shale could be won cheaply, and, given modern techniques, that the Nevis could provide the nucleus of an indigenous oil industry in New Zealand.

The only oil shale deposits ever previously worked in New Zealand were at Orepuki, 44 miles west of Invercargill, where the New Zealand Coal and Oil Company suspended operations early in the century because of mining difficulties. The shale here is underground and is difficult to mine because of the structure of the bearing seams, the depth of the shale and danger of fire at the underlying coal seam. The average crude oil yield is, however, high.

To investigate the New Zealand ironsands and to study the prospects for an iron and steel industry founded on them, the New Zealand Government is sponsoring a research company with £250,000 available for exploration and investigation work. Such an industry, it is claimed, would cost £30,000,000 to establish, and, in view of the failure of other private companies in the past to work these sands, the government is proceeding with caution.

ECONOMICS OF THE TURKISH CHROMITE INDUSTRY

A detailed statistical analysis and economic appraisal of the Turkish chromite industry by Thomas G. Murdock, American Minerals Attache in Ankara, has been published in *Mineral Trade Notes* as Special Supplement No. 57, July 1959. The report was prepared before May 6, 1959, when the Turkish chromite industry was granted a full 9 Turkish lira per dollar exchange rate for exports. It remains timely, however, because of the detailed treatment of the industry's competitive position. (As from mid-August, this 9 lira per dollar rate applied to the majority of exports.)

To obtain as representative average figures as possible, the analysis covers the 10-year period 1948-57 inclusive, which was an important cycle in the history of Turkish chromite

mining. Roughly coinciding with the recovery of European metallurgical demands, there was an almost continuous build-up of production, with consequent increased investments, some additional mechanization, and exploration for new deposits. Then, as happened with other minerals, world production began to exceed current demand and Turkish exports tended downward.

The analysis takes into account the almost constantly rising labour costs, increased material and transportation charges resulting largely from foreign exchange shortages, and, conversely, government efforts to aid the industry through reduced royalties, barter arrangements, and by allowing full utilization of foreign exchange earnings from exports of low grade ores for imports of supplies and equipment.

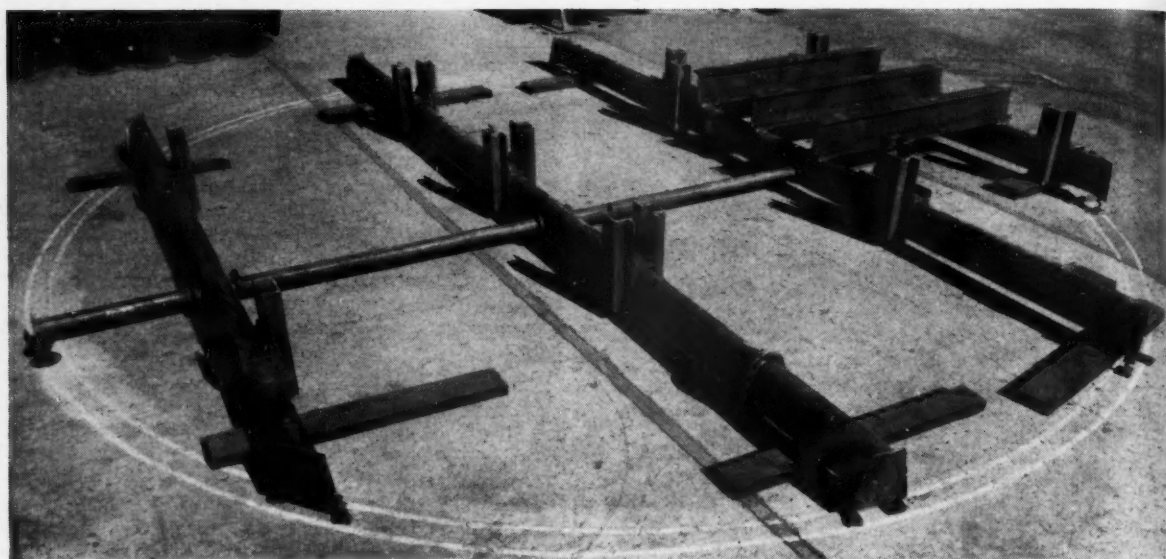
Regardless of the exact figures on costs of chromite production in Turkey, the following conclusions seem valid:

1. The price of Turkish chromite ore has not advanced over the 1948 price in the same proportion as costs.
2. As compared with costs during recent years, except for royalty, all elements have risen appreciably. Some items have shown substantial increases, particularly labour costs, and there has not been a compensating increase in productivity.
3. Production costs of other minerals have not risen out of proportion to the previous levels to any greater extent than have those for chromite, and on this basis the existing system of differential premiums seems unwarranted. While there are reasons that justify encouraging their production, there are equally good ones for encouraging maintenance of chromite production.
4. Competition from Rhodesia has been steadily increasing and the price differential in favour of Rhodesian ores has been such that only the superior quality of the Turkish product has made it possible to obtain the higher prices. The activity of U.S. consumers in the African mining field indicates that this superiority is not sufficient to overcome adverse economic considerations.
5. Based on the limited data available the cost of production in the two areas has shown very little difference. Profits by Rhodesian producers have apparently been smaller. Under present conditions in Turkey, rising production costs there are such that competition is extremely difficult, despite the favourable price differential. To compete for the limited market, prices will have to be lowered and such a decrease will mean little, if any, profit to producers.
6. The claims of the producers as to the inadequacy of the TL2.10 premiums seem valid. Even assuming a certain exaggeration in some of their figures, their basic premise seems correct.

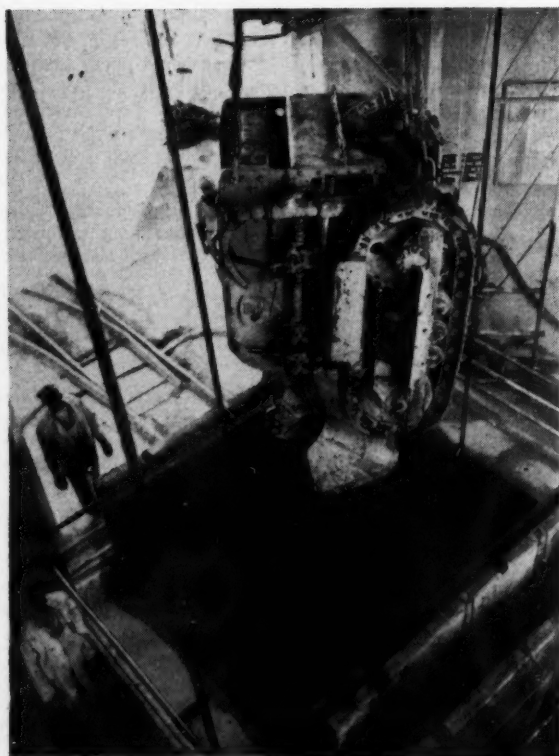
UNION COAL EXPORTS

It is announced that coal in small quantities is again leaving South Africa for markets in West Africa, but in general, conditions are still unhealthy. As in Europe, demand for coal is shrinking as traditional markets are lost in the world-wide switch to fuel oils. This switch was accelerated in Africa by the previous inability of the indigenous producers to maintain regular supplies of coal. This inability to maintain supplies led to U.S. coal being imported into eastern markets formerly supplied from Durban.

Virtually South Africa's only hope of bulk selling lies in South America and a mission recently left the Union to attempt to establish a market in Argentine, Uruguay and Brazil. However, quite apart from the difficulty of transporting large coal tonnages to Durban there are also currency problems to solve. Currently South Africa's coal exports are running at about 50 per cent of last year's figures.



ENGINEERING ACHIEVEMENTS AT WESTERN DEEP LEVELS



ENGINEERINGWISE, Western Deep Levels is the best "show" mine that the Union of South Africa has ever had, writes our South African Correspondent. This is due partly to its being the biggest project ever undertaken but more to the amount of planning that is going into it and the methods and equipment being devised to bring it to production rapidly and to obtain the maximum of efficiency once in operation.

Reference has been made by our Correspondent on previous occasions to the high rate of shaft sinking being achieved in what is most difficult ground, it being pointed out that after making allowance for time lost in cementation work, monthly footages have been in excess of anything achieved elsewhere in the world.

Cleaning in the two main 26 ft. shafts has been done by mechanical grabs from the start, but the ventilation shafts were started off using manual lashing by highly-skilled Basuto teams. There has now been a changeover to the use of crawler-mounted rocker-shovel loaders.

With these, sinking has been proceeding on a three-shift basis with an average advance of 6 ft. a shift producing 222 tons of broken rock per round. Hoisting is by double-drum hoists and six-ton kibles. These are easily filled to capacity by the loaders, giving a rate of between 12 and 14 kibles an hour from below 5,000 ft.

Cleaning crews have been reduced to two Europeans and six Africans. The latter operate the loaders.

The loaders used at Western Deeps are standard Eimco Model 630, modified to pass through the 5 ft. 6 in. diameter opening in the sinking stage (see left). Two loaders are available at each shaft, but only one used at a time. The loader is lowered after each blast and hoisted to the surface at the end of the cleaning period for servicing.

As is obvious, adequate ventilation is a top priority in all Western Deep Levels' planning. Towards this, much research has gone into cutting down air resistance of shaft equipment. Anglo American engineers, under the direction of Mr. D. M. Bentley, consulting engineer (design and development), and a South African engineering firm, Hall, Longmore, with which General Mining is associated, have developed prototype shaft buntons. Tests by the Council for Scientific and Industrial Research have shown that these have some 60 per cent less air resistance than

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those fabricated from the conventional "I" type beams. This saving is substantial since about half the total air resistance in a shaft can be attributed to internal structure.

The new type of beam (shown opposite) is of a pipe-like section, with rounded top and bottom and flat sides. These are concerted in the sides of the shaft. Apart from the lessened air resistance, the new buntons are lighter than the "I" section type and have a greater degree of stiffness. This latter aspect makes it possible to use one stabilizer per set instead of the usual two or three. The cost is slightly higher—about £68,000 for a 6,000 ft. shaft against £62,000—but it is estimated that the saving in ventilation costs will be of the order of £18,000 a year.

These buntons will be installed at 15 ft. intervals in the Western Deep Levels' main shafts since the original planning was done on this basis. They will, however, go in at 20 ft. intervals in Vaal Reefs new shaft, since this greater spacing has become possible as a result of the increased rigidity provided. Cross supports, shown in the far side in the

picture, for pipes and the like will be installed at 400 ft. intervals. For these "I" section girders will probably be used, since their effect on air resistance at this distance is probably of little significance.

At the same time the Council for Scientific and Industrial Research, at the request of one of the mining houses, is investigating whether shaft conveyances cannot be run on rope guides instead of the usual rigid steel guides held in place by buntons. This system is used over limited distances in shafts with only two conveyances.

The basic research is into safe clearances for multiple conveyances in a shaft, about which little information is available. A dynamic scale model of a shaft has been constructed—150 ft. in depth and 12 in. diameter complete with a model hoist, braking system and fans to simulate the movement of ventilation air. Additional work to be done using this model will be precipitation of water in shafts, dynamics of conveyances on solid guides and airflow resistance caused by moving conveyances.

Expansion of East Germany's Mineral Industry

FOLLOWING the Communist economic theory of doing things on a large scale in the way of production, the East German Government is continuing its policy of building up large-capacity mineral mining and processing plants and combines after having closed many of the country's smaller production units during the course of last year. The need for mineral raw materials is growing steadily in importance, first because of the need to feed the East German heavy industries to keep up output within the Comecon—Eastern Europe's OEEC—schemes and its own five-year plans and secondly to make East Germany to a certain extent independent of importing from the Western world. At present East Germany is rather lagging behind in the production of many minerals, and even with the ambitious schemes planned for the future, imports of the basic materials are to rise in coming years. Nevertheless, productivity is on the rise and there is a great amount of official keenness on raising production standards. The penalties for plant executives who fail to keep up production are hard.

New Smelting Processes

Most ambitious scheme under way at present is that for the reorganization and the introduction of new smelting processes to the Mansfeld Combine. Mansfeld copper ore contains copper and quantities of silver, lead, zinc, selenium, germanium, thallium and rhenium. The quantities of the last six metals contained in the Mansfeld ore and of those produced as by-products during smelting are said to be sufficient to cover the combined East German demand. Up to now only a fairly small amount of these metals has been obtained at the Combine, whose main interest has been in copper and silver production. Now a novel crude smelting system is to be introduced to the Combine at the same time as the lead-zinc production scheme is reconstructed. Copper production at the August-Bebel Works, a part of the Mansfeld Combine, is to be increased by rationalization and reconstruction of the present plant. This modernization scheme, together with the improved consumption of raw materials and scrap, will mean that in the future some 60 per cent of the country's copper demand will be met by home production.

The first electrolytic zinc from the Freiberg smelting plant—East Germany's first—will be produced in 1961.

By October of this year a zinc blende roasting plant and a catalytic plant for the production of sulphuric acid from Freiberg zinc blende and Elbingerode pyrites will come into full operation. Total output by the end of 1959 will be 9,000 tonnes.

Work continues on the building of the nickel refinery at St. Egidien. The government now announces that, with native oxydic ores as base material, the plant will work with new processes developed in East Germany for the production of nickel and ferro-nickel with a high nickel content from nickel-iron billets. The continuous process is already in operation on a semi-commercial scale; it is said to allow 95 per cent use of the nickel content.

Lithium is soon to be produced by the country's main tin producer, VEB Zinnerz, at its plant in the Altenberg tin deposits.

Rising Coal Output

Coal production rose on all sides, with a particular increase in the case of brown coal, one of the country's main mineral holdings. Production per head of population of hard coal was last year 167.3 kilogrammes, as against 152.5 kilogrammes in 1950 and 218 kilogrammes in 1936; pre-war production figures are still well above those for today. Raw brown coal produced per head of population was up by a striking amount on all previous levels, however, last year reaching a total of 12,386.6 kilogrammes, as compared with 7,453.2 kilogrammes in 1950 and 6,253.5 kilogrammes in 1936. A huge new brown coal combine is starting to come into operation—the "Black Pump" combine at Hoyerswerda. This 5,930-acre plant, which will produce briquettes, coke, gas, power and coal by-products will be in full operation in 1963, with an initial daily production of 100,000 tonnes of brown coal. At the Gluckauf brown coal site, what is claimed to be the world's first-ever all-welded transporter conveyor is now in service. The 2,650-tonne conveyor with a span of 690 ft. and a cantilever length of 246 ft. removes and transports to a waste dump some 7,670 cu. yds. of overburden per hour.

With the need to use all types of hard coal available—imports are to rise further in the future—a power station using otherwise non-commercial salt coal is being erected at the Walter Ulbricht plant.

WITH the vast modernization plans now in hand a new phase in the freight-carrying operations of British Railways is now revealing itself and much is being done to meet the needs of industry, especially in the carrying of bulk freight loads. Though many of the major developments concerned with freight in the railway Modernisation Plan are of a long-term character and their full benefits will not be realized for some time, in many directions, other lesser but nevertheless important projects which have been completed, are producing results now and are enabling the railways to provide freight services of growing reliability and speed.

In the case of transport in bulk, 70 per cent of the deep-mined coal needing transport goes by rail, and coal-class traffic in 1957 totalled nearly 167,000,000 tons. For the iron and steel industry 18,000,000 tons of ore, 22,000,000 tons of iron and steel scrap, and nearly 4,000,000 tons of pig iron are moved annually.

Already large, the bulk-carrying of British Railways and British Road Services is expanding almost daily, and

Progress in Bulk Freight Transport

British Railways are steadily increasing the sizes of their wagons. In a recent year, they produced over 33,000 all-steel 16-ton coal wagons, 4,500 hopped wagons of 21 tons capacity, 1,300 25½-ton iron ore hopper wagons and 530 33-ton capacity iron ore hopper wagons.

While the 16-ton mineral wagon is regarded as a "maid of all work" for bulk cargoes, it is the policy of British Railways to use the biggest wagons for which loads can be found up to the limit of the load the track will take.

Hopper Wagons

A very large volume of coal and other minerals is transported in the fleet of 21-ton hopper wagons, which is now some 36,000 strong. There are also 10,000 21-ton flat-bottomed mineral wagons. Many of the wagons run in "block trains" over long distances from collieries direct to merchants in main industrial and residential centres.

Important companies, in the Charrington, Gardner, Locket and Company Ltd. group, have mechanized coal depots designed and built specifically to speed up coal deliveries covering wide areas. British Railways and the National Coal Board have co-operated from the early stages of these developments. A number of 21-ton wagons are reserved for circuit working to feed one of the new depots.

Also making an important contribution towards the economical transport of bulk materials in all parts of the system, is the 24½-ton hopper mineral wagon. For widespread use, it allows the highest possible gross weight for a wagon with two axles and a 12-ft. wheelbase. Built of welded steel throughout, the wagon is hopped with four hinged doors which can be operated from either side of the wagon. The contents are discharged between the rails to the bunkers below.

The largest hopper wagon in service is the 56-ton iron ore hopper wagon, which is the result of the combined thought and planning of the Tyne Improvement Commissioners, the Consett Iron Company, and British Railways, in their search for a high-capacity iron-ore wagon capable of speedy handling and operation. The 56-tonners are fitted with vacuum brakes enabling them to travel at high speed. They are unloaded as a train through power-operated doors. A train of nine of these wagons can convey about 500 tons, and the entire load can be discharged into gantry hoppers within 60 seconds of door release. The record discharge time is 35 seconds.

Pressed Steel Containers

Almost 5,500 L-type containers of pressed steel construction are in service for carrying materials such as dolomite, alumina, limestone and cement in bulk. Each container has two separate compartments and each compartment may be discharged independently through bottom doors operated by a simple lever. Dust during unloading can be prevented by the use of sheets attached to cleats. Among

the advantages of these containers is the elimination of bags, sacks, etc. and of costly manhandling.

Special Vehicles

For the specialized transport of cement, British Transport, with the help of the cement industry, have developed a highly efficient system. They have produced a special 20-ton all-steel closed wagon, which is pressurized for pneumatic discharge of the contents. Hundreds of these wagons are now in service and orders in hand will bring the total up to 1,180. Other minerals for which these vehicles are suitable are alumina, salt, fuller's earth, powdered lime, pulverized fuel, and slate dust.

An unusual wagon has been built for the conveyance of road-making materials. The wagon itself is fitted with cradles into which are fitted four metal skips. Handled by crane, the skips are discharged into waiting road vehicles by a simple lifting and tripping gear. About 400 of these wagons are now in service.

Of the total fleet of over 1,000,000 rail freight vehicles owned by British Railways, the proportion of modern wagons is continually increasing. Their average loading capacity is also going up, and a quarter of the total are fitted with vacuum brakes for fast running. By the end of 1959, wagons so fitted will number 337,000. In 1938, there were 300 fast freight trains each week day. Today, the figure is about 760 and more are being run each month.

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U.S. Mine Research Programme

THE research programme of the U.S. Bureau of Mines on uranium and thorium in the fiscal year 1960 will include studies in the mining and metallurgy of radioactive raw materials, and investigation, appraisal, and use of nuclear techniques in minerals research. In addition, Bureau scientists will seek ways of minimizing stream and ground-water pollution from radioactive uranium-mill wastes by developing improvements in milling operations. Approaching this problem in several ways, they will try to reduce the amount of plant solution discarded by prolonging solution recycling, attempt to develop processes for recovering uranium from clear solutions and leach slurries, and investigate new leaching techniques and simplified recovery procedures for fringe-area deposits.

Testing of ores for amenability to treatment and such other physical and chemical studies as may be required by the Atomic Energy Commission will be continued, and progress is expected in research to develop new and improved techniques for beneficiating off-grade ores. This includes tests on attrition grinding, physical beneficiation, and hydrometallurgical processing of uranium-bearing materials, emphasizing simple and inexpensive methods.

Reports on methods and costs at virtually all types of domestic uranium-mining operations will be published to provide the industry with information that will promote safety and efficiency. Rock mechanics of the ore-bearing formations in the Ambrosia Lake area, McKinley County, N. Mex., will be studied to obtain data needed for planning a ground-control study. Research to develop techniques for producing high-purity thorium by modifying the Kroll process will continue, and the Bureau also will study electro-winning of uranium metal from molten electrolytes.

Beryllium and Source Metals

The Bureau of Mines has also announced that it is intensifying research on beryllium and its source minerals. Under the new programme, it will step up a nation-wide search for beryllium ore, build and operate a small plant for recovering low-grade beryl experimentally by flotation, and expand metallurgical studies to find ways of assuring adequate supplies of beryllium, both for the long-range needs of industry and for potential use in aircraft, missile, electronic and nuclear fields.

In its search for beryllium minerals, the Bureau is sampling promising deposits and classifying them by mineral content, estimated size, geological type, location, and ease of mining. This work begun last year in New England and in several Western States, will continue in the fiscal year 1960 and will be extended for the first time to Alaska. Some of the more promising areas will be explored in detail.

Besides analysing ore samples obtained in the field, Bureau metallurgists will conduct mineral-dressing tests, when practicable, seeking recovery of beryl by various methods including Bureau-developed flotation techniques. A small experimental flotation plant to be built this year will be operated continuously to determine whether the small quantities of beryl in North Carolina spodumene can be recovered economically. Beryllium concentrates obtained from ore-dressing studies will be reduced to salts and then to metal in Bureau laboratories. The Bureau also will continue research begun last year on various processes for producing high-purity beryllium metal and evaluation of the products obtained.

During the next 12 months, the Bureau will complete an investigation of domestic sources of caesium and rubidium and begin research to develop a simple field test for these elements. At the same time, complementary mineral-dressing, extraction, separation and reduction studies are being carried forward to develop practical methods for recovering high-purity caesium and rubidium salts and metals. The thermodynamic properties of selected caesium and rubidium salts also are being studied. In addition, the Bureau is seeking processes for recovering rhenium by direct extraction from molybdenite concentrates and from other promising sources. A wide variety of ores is being analysed for small quantities of rhenium.

Research in Tellurium

To meet the needs of the rapidly developing electronics and thermoelectrics technologies, the Bureau has announced the beginning of an intensive new research programme for tellurium. The programme, which began July 1, at the start of the 1960 fiscal year, will include a widespread search for new domestic sources of this element.

Tellurium, now obtained only as a byproduct of copper and lead refining, has been highly publicized as a semiconductor material capable of converting heat to electricity or the use of electrical energy for the generation of heat or cold. Expanded use of thermoelectric devices would create a demand for tellurium far in excess of supply. Thus, the Bureau will seek to determine how much tellurium might be produced from new sources.

The new research effort, which will be conducted at the Bureau's Salt Lake City, Utah, and Spokane, Wash., installations, also will include investigations to evaluate the possibility of improving tellurium-detection methods and analytical techniques.

Research in electrolytic reduction of rare-earth metals, which led recently to experimental production of high-purity cerium by Bureau of Mines metallurgists, will again be emphasized. In addition to the work in electrolysis, the Bureau is trying various solvent-extraction and ion-exchange techniques in efforts to develop a continuous process for recovering rare-earth metals from ores, concentrates, and mill residues and separating of individual rare-earth elements. It also is continuing investigations of the physical properties of high-purity cerium and other rare-earth metals that have potential industrial uses in alloys or as structural materials.

Improved methods for producing superior metals, alloys, and compounds needed in nuclear-energy, astronautics, electronics and other important fields will be sought in an accelerated columbium-tantalum research programme. New projects will emphasize low-grade domestic raw materials as sources of the two metals.

The Bureau is evaluating potential domestic sources of columbium-tantalum ores in Alaska, Arizona, Colorado, Connecticut, Idaho, Maine, Montana, New Hampshire, New Mexico, and South Dakota. Work has been expanded on developing urgently needed methods for the rapid field identification of columbium and tantalum in minerals to aid prospecting. Studies also are beginning on the identification, classification, and physical constants of complex columbium-tantalum-bearing minerals to enable more accurate evaluation of resources and to aid mineral dressers and metallurgists in selecting methods for beneficiating the ore and extracting metal values.

Machinery and Equipment

New Industrial Hose Material

It is claimed that a recent development in the flexible hose industry may soon replace in many fields the conventional rubber and metallic flexible hose.

P.T.F.E. (polytetrafluoroethylene) is in many respects a remarkable material which has for a number of years been confined to a relatively small variety of specialized and expensive applications. Developed by William Rose Ltd., its advent into the flexibles field is of interest because P.T.F.E. has characteristics in contrast to the existing standards for flexible hose.

Despite its light weight construction, P.T.F.E. is claimed to outlive conventional metallic and special rubber hoses even under arduous flexing duties. It possesses extremely small bending radii (e.g. 1 in. on the $\frac{1}{2}$ in. bore tube and 4 in. on the $\frac{3}{4}$ in. bore tube) and is able to absorb misalignment not previously possible with metallic hoses where the ever present danger of metal fatigue may give rise to early failure.

With an extremely low co-efficient of friction, which means that it is virtually self-lubricating, P.T.F.E. tube provides for a rapid and smooth evacuation of the conveyant. This low frictional resistance and its smooth bore obviates turbulences and logging which sometimes occur with corrugated pattern hoses. A working life in the order of 3-5 years is possible, and obvious applications may be envisaged in mining, particularly in surface installations.

Providing the hose is cleansed thoroughly, P.T.F.E. tubing will convey a multitude of liquids and is resistant to most known chemicals including such acids and corrosives as chromic-nitric and

sulphuric acids. At the moment the only known media which are harmful to it are molten alkali metals and fluorine compounds. Outwardly the P.T.F.E. tube is usually protected with closely woven wire braiding and asbestos sheath for insulation can also be provided.

P.T.F.E. hoses possess a wide working temperature range of -80 deg. C. to 250 deg. C. although under certain circumstances they can remain serviceable at temperatures as high as 300 deg. C. On a $\frac{1}{2}$ in. bore P.T.F.E. hose a working pressure of $5,000$ lb.s.i. can be achieved; with a 1 in. bore up to $2,500$ lb.s.i. can be reached. At the expense of flexibility very high pressures can be achieved by multi-braiding and some P.T.F.E. hose assemblies have reached $20,000$ lb.s.i.

A simple but robust re-usable fitting can be offered in a variety of metals including brass and stainless steel. British and Foreign Patents are held for this unique fitting.

NEW MINE WINDER

By deciding to sink new shafts at Hucknall No. 2 Colliery (where the more accessible coal deposits are exhausted), the N.C.B. plans, by 1961, to raise coal from this pit at the rate of 320 tons an hour from a depth of 1,908 ft.

The mine which is in No. 6 Area, East Midlands Division, had originally two areas of coal, known as the Top and Bottom Pits, and in order to reach the Bottom Pit new shafts were necessary. The drive for the winding equipment for the new shafts, to be supplied by the A.E.I. Heavy Plant Division, will consist of a

1,400 h.p. d.c. motor fed by two Type MB6/13G1 pumpless steel-tank mercury-arc rectifiers. At first, the winder will have manual closed-loop control, but there will be provision for extension to automatic control in the future.

The equipment, which is to be installed in December, 1960, will include a drum 18 ft. in dia. and 13 ft. wide, manufactured by Robey and Co. Ltd., and the brakes will be of Robey's new high-pressure type.

FLAME-PROOF ELECTRONIC GAUGE

A new model of the Gilbarco electronic tank gauge for use on deep storage tanks, is shortly to be available from Firth Cleveland Instruments Ltd., a member of the Firth Cleveland Group. The new model, CMB 107U, is housed in a ductile iron case and meets American Class I Group D. Division I requirements for flame proofness.

The gauge reads the true level of the liquid in feet, inches and sixteenths, regardless of its specific gravity. It is power-actuated to overcome the effect of varying friction in pulley sheaves, and the variation in the weight of the measuring element at high and low liquid levels. It can be adapted to almost any type of remote transmission, and provides the basic accurate data necessary for a co-ordinated system of remote transmission. The gauge can be equipped for automatic selection of temperature averaging resistance thermometers, and can be fitted with high and low level alarms.

All metals and other materials used in the gauge are selected to resist corrosion. It can be installed, serviced, recalibrated and maintained without taking the tank out of service. The gauge may be installed to measure water level or the interface of two products.

In multiple storage tank installations, the gauge on each tank can be connected to a Firth Cleveland Gilbarco null-balance receiver for remote liquid level and average temperature readings. The standard receiver is equipped to read this data from 30 tanks. Since no current flows through the instruments when readings are being taken, errors caused by transmitter loading are eliminated. The receiver incorporates a means of remotely checking and proving the accurate operation of each gauge from the instrument house. An air purged version of this receiver can be supplied for mounting in hazardous areas.

PLASTIC TRANSMISSION BELTING

A new catalogue for Dixylon plastic transmission belting, the precision belting for high speed drives, stated to be stretchless, silent and smooth running, has been published by R. and J. Dick Ltd. The catalogue, which describes in detail Dixylon plastic transmission belts that will operate at velocities of 10,000 ft. per min., gives much useful information on belt thicknesses, co-efficients of friction, horse power rating per width of belt, etc.

A development of the new plastic belting is Dixylon Suplex an oil-resisting belt which retains its co-efficient of friction even when operating where large quantities of running oil are present. Anti-static Dixylon belting is also available with electrically conductive properties specially designed for use in industries where belt drives operate in the presence of inflammable vapours and explosive dusts.

Internal and external construction of P.T.F.E. hose, showing fittings



MINING MISCELLANY

It is reported from Canada that Noranda Mines has made arrangements to use, if it so desires after completion of a laboratory and pilot plant programme, a new metallurgical process for the treatment of zinc sulphides discovered in a research programme conducted by Sherritt Gordon Mines. Laboratory work to date indicates that the new process will recover a higher percentage of metal than is obtainable by standard methods.

Giant Nickel Mines Ltd. has signed a three-year contract with a Japanese firm for the sale of all nickel concentrates from its mine near Hope, 100 miles east of Vancouver, British Columbia. The first shipment is expected to leave in February next year.

Dow Chemical Co. has developed the first die-casting alloy for use at temperatures beyond 800 deg. F. It contains 1 per cent each of thorium and manganese, the balance being magnesium. The density is only 0.064 lb. sq. in. Aircraft and missile uses are indicated.

By arrangement with the Department of Scientific and Industrial Research, the Iron and Steel Institute is undertaking the monthly publication of a complete English-language version of the Russian monthly journal *Stal*. This is the major Russian periodical in the sphere of iron and steel-making technology.

Mr. R. L. Garner, President of the International Finance Corporation (IFC), announced yesterday that the Corporation has agreed to invest an additional \$900,000 in Empresa Minera de Mantos Blancos, S.A., a Chilean corporation, which has under construction a copper mining and smelting project in the Antofagasta region of northern Chile. Mantos Blancos is controlled by Em-

presas Sudamericanas Consolidadas, S.A., a Panamanian corporation holding the mining, industrial and commercial interests of Dr. Mauricio Hochschild and associates. In August, 1957, IFC agreed to invest \$2,200,000 in this new company which is opening up a new copper mine and introducing a new metallurgical process for refining copper. The original project was designed for processing 2,000 tons of ore a day. The additional IFC investment of \$900,000 is part of the financing required to increase the processing capacity to 3,000 tons a day. It is expected that this increased capacity will result in a substantial reduction in the company's cost of producing refined copper. The total cost of the project is \$18,600,000, of which \$5,800,000 is related to the expansion. Of this latter amount \$2,900,000 will be invested by the Hochschild group and the balance by IFC, together with Chemical International Finance Ltd., \$1,200,000; the Bank of America, \$600,000; and \$200,000 in suppliers credits. IFC's total investment of \$3,100,000 will be in the form of U.S. dollar Notes bearing interest at 7 p.c., with amortization to be completed in 1968. In addition, IFC is to receive payments depending on the amount of dividends, and option rights to purchase at par Mantos Blancos' common stock. The IFC investment is subject to completion of the necessary legal formalities.

Under the Technical Aid Agreement concluded between West Germany and Indonesia, the implementation of which was recently discussed in Bonn between representatives of both governments, West German experts will examine the possibility of exploitation of a zinc ore deposit, for which project West German firms have made available credits on moderate terms.

The ore discriminator at Mary Kathleen in north-west Queensland through which trucks, bearing uranium ore, pass through from the mine to the treatment plant. Six geiger tubes fitted to the roof register through a scintillometer the degree of intensity of radioactivity in counts per second of the ore. The counts per second are converted to pounds weight U_3O_8 per ton, and the ore goes on for processing



PERSONAL

We regret to report the death, on August 25, of Mr. T. R. A. Windeatt, a director of the following Malayan tin mining companies; Killinghall Tin Ltd., Gopeng Consolidated, Hong Kong Tin, Chenderiang Tin Dredging, Tekka Ltd., and Kent (FMS) Tin Dredging.

Mr. W. R. Booth has been appointed financial director and secretary of the Goodyear Tyre and Rubber Co. (Great Britain) Ltd. He succeeds Mr. H. A. Brundage, who has returned to the headquarters of the Goodyear Company in Akron, United States.

Mr. P. V. Emrys-Evans, a director of the British South Africa Co., has been elected vice-president of the company.

Mr. H. C. Horsup, secretary of Ransomes and Rapier Ltd., having reached retiring age, will retire, after nearly 40 years' service, on September 30. He will be succeeded by Mr. G. N. Rodgers.

The nine members of the new High Authority of the European Coal and Steel Community which will take up its duties on September 15, are Messrs. Albert Coppe, Paul Finet, Fritz Hellwig, Pierre-Olivier Lapie, Piero Malvestiti, Heinz Potthoff, Roger Reynaud, Dirk Spierenburg, and Albert Wehrer. The six governments must now appoint the president and two vice-presidents of the High Authority, after consultation with the latter.

Mr. Lloyd B. Antonides is now mining engineer for Associated Metals and Minerals Corporation of 75 West Street, New York, 6. One of his major interests will be in developing new sources of minerals and metals for the company's world-wide trading activities.

Mr. H. Riggall, managing director and deputy-chairman of Ruston and Hornsby Ltd., is relinquishing his executive responsibilities as from December 31, by which date he will have reached the normal retiring age. He will remain with the company as a non-executive director and as deputy-chairman. He will also retain the chairmanship of Ruston and Hornsby (Australia) Pty. Ltd., an appointment he has held since 1949. His place as managing director will be taken by two other directors, Mr. V. R. Prehn and Mr. G. W. Bone, who will become joint managing directors on January 1, 1960.

CONTRACTS AND TENDERS

India

Diamond core bits. Various lots, bevel wall, casing and casing shoe. Diamonds first grade W. African bortz equivalent to G grade of J. K. Smit set in 50-60 Rockwell C nickel beryllium alloy. Bids to the Director General of Supplies and Disposals, Shahjahan Road, New Delhi. Closing date October 6, 1959. Ref. ESB/20780/59. Telephone Chancery 4411, extension 738 or 771.

South Africa

One crawler type tractor. Diesel, 10-hr. draw bar rating not less than 142 h.p. under specified ratings. Also front mounted, single drum cable control unit and straight blade dozer. Bids to The Secretary, Union Tender Board, 291 Bosman Street, P.O. Box 371, Pretoria. Closing date September 23, 1959. Ref. ESB/20985/59. Telephone Chancery 4411, extension 738 or 771.

Metals and Minerals

U.S. Magnesium Demand

U.S. demand for magnesium continues to show signs of recovery from the recession in consumption which began towards the end of 1957. Shipments of primary ingot during the first and second quarters of 1959 were respectively around 10,300 and 12,500 s.tons, compared with 7,700 and 8,300 tons in the first two quarters of 1958. Total U.S. consumption last year was a little over 34,000 tons (51,570 tons in 1957).

Nevertheless, the recovery in demand for magnesium has been less noticeable than in other metals such as steel and aluminium, mainly because magnesium has been more affected by revisions in defence production schedules. Consequently, while defence still provides a substantial foundation for the market, the future of magnesium in the U.S. is seen more and more to lie in the expansion of commercial demand, and research is being concentrated on the development of new uses. It will be recalled in this connection that one of the causes of decline in American consumption last year was the decrease of more than 50 per cent in the use of magnesium as a reducing agent in titanium production.

That the expansion in demand for magnesium is unlikely to go ahead very rapidly is underlined by the announcement that Alcan, after prolonged study of the present economics of its magnesium-producing facilities, has decided to suspend their operation indefinitely.

The magnesium plant, which has operated as a minor division of Alcan's aluminium smelting facilities at Arvida, Quebec, has an annual capacity of 4,000 tons of magnesium ingot. In recent years the plant has operated at rates substantially below capacity, producing magnesium mainly for export to world markets.

In future, Magnesium Co. of Canada, Ltd. (MAGCAN), an associated company engaged in the sale of magnesium in Canada and overseas, will obtain its magnesium requirements through agreements made in Canada and the U.S. Under the U.S. arrangements, MAGCAN will obtain a portion of its magnesium requirements from the Dow Chemical Co., delivering to them a *pro rata* tonnage of Alcan's aluminium ingot in exchange.

CANADIAN AND AUSTRALIAN URANIUM REGULATIONS

A change in the rules governing the supply of uranium to countries with which Canada has no agreement was recently announced by Mr. Gordon Churchill, the Minister of Trade and Commerce. Last May it was stated that any one private producer could only supply such non-agreement countries with a total of 250 lb. The total sales to any one country were limited to 2,500 lb. It has now been decided to allow any part or the entire 2,500 lb. to be supplied by one producer. There is still no change in the upper limit of 2,500 lb. to any one producer.

Somewhat similar regulations are now in force in Australia. The policy of the

Commonwealth Government has been to restrict exports of uranium oxide to Great Britain and the United States. This policy is now to be modified, and exports will be permitted to countries in need of small quantities for chemical analysis and test work. Under the new plan, companies will be able to export a total of 2,500 lb. to any one country, but individual sales will be limited to 250 lb. The first export licence has been issued to Mary Kathleen Uranium Ltd., for the export of small samples of uranium oxide to Japan. The agreement is stated to contain safeguards to ensure that the materials supplied are used solely for peaceful purposes.

Confidence in uranium's longer-term future is expressed by Mr. A. W. Stollery, vice-president of Consolidated Denison, who believes that it could be one of shortage rather than surplus. In a survey of the Canadian uranium industry prepared for Business Atomic Report, he stresses that, while there is a possibility of a surplus of uranium over the next decade, and whole some producers will either be mined out or will find themselves with a grade of ore too low for economical mining after fulfilling their present contracts, eventually large producers will be hard-pressed to keep up with the inevitable increase in the demand for uranium.

This confidence in the longer-term outlook—widely held among producers—is, of course, based partly on technological progress and partly on the growing demand for nuclear power, not only—as Mr. Stollery puts it—from “the power hungry nations of the West already engaged in nuclear power production, but also from underdeveloped ‘have-not’ nations of Asia and Africa”.

Mr. Stollery further points out that there has been no indication that demands for military applications of uranium will diminish in the near future, while the potential conversion of entire fleets to nuclear power holds great promise.

WOLFRAM ROCKETS UP

Wolfram's reputation for meteoric price rises and falls has continued to be more than upheld this past week, in which the London price of 65 per cent ore has moved from 115s./120s. up to 160s./167s. per unit, c.i.f. Europe. During the previous week, prices had advanced by about 15s. Apart from the strong demand from special steelmakers in this country, demand is generally strong throughout the world, not least in the U.S. despite the steel strike. The principal impetus in this week's price rise appears to have been the continued strength of Japanese interest, although Western Germany and France have also been prominent bidders.

The price rise appears to have taken place on a relatively small turnover and there are signs that, with stocks of ore becoming depleted, dealers have been limiting their daily offerings.

As was suggested in this column last week, it is probable that the pressure of Japanese buying stems from the low level

to which production has fallen in countries such as Thailand, Korea and Burma, which are Japan's natural sources of supply, but if today's price were to be sustained for any length of time, we would no doubt quickly see these and other inactive producers starting up again.

Market circles have also been pointing out this week that the Board of Trade still holds substantial unsold stocks which it ceased selling when prices were declining two or three years ago. At present prices the B. of T. might well come back into the market, more especially if offerings could be shown to be embarrassingly light.

TIN SMELTER FOR INDONESIA ?

An agency message from Djakarta suggests that Indonesia is again re-examining the possibility of establishing her own smelter to deal with domestic production. This is not the first time that such a project has been proposed in recent years, although in the past such plans have been linked to projected offers of American foreign aid. It is difficult to see this undertaking being launched without foreign aid and in terms of economic necessity, it is still more difficult to see the justification for such a project taking priority over the multitudinous other capital requirements for Indonesian reconstruction.

MORE INTEREST IN MANGANESE

Although the London manganese market is still nominal with no business reported, there is a somewhat better tone with enquiries being received which provide the first hope for some time that manganese may be pulling out of the depression in which it has lain this past year, or more.

The two factors which are effectively retarding any immediate recovery are, first of all, the uncertainty regarding the eventual fate of the U.S. barter deal with India, under which India is required to deliver 150,000 tons of low-grade ore and 75,000 tons of ferro-manganese in return for wheat, and secondly, the continuation of the American steel strike.

The commencement of shipments under the Indian barter deal has now been dragging on for so long that the price relationship between manganese and wheat has, in the meanwhile, changed to the point where the original terms of the deal have become somewhat artificial.

Against this, the fact remains that India has large disposable stocks of manganese which must be expected to come on the market, one way or another, as demand improves.

THORIUM AS A NUCLEAR FUEL

Although it has latterly appeared that thorium is unlikely to be important as a nuclear fuel for at least a decade, it is noteworthy that the U.S. Atomic Energy Commission has initiated a long-range programme to develop effective thermal breeder reactions, which would make full use of the latent energy in this material. Thorium is an element which, when bombarded with neutrons, is converted into fissionable uranium-233. The new programme has as its objective the development of a thermal breeder reactor capable of converting thorium to fissionable fuel material at a doubling time of not more than 25 years.

COPPER • TIN • LEAD • ZINC

(From Our London Metal Exchange Correspondent)

In spite of the fact that 75 per cent of the U.S. production of copper and 45 per cent of the production of refined lead is idle, the period under review has been one of the quietest of the year. All that can be said is that the undertone of the copper market seems to be firming up, whilst that in the zinc and tin market remains satisfactory. The lead market is still the odd one out with the undertone weakening.

SUBSTANTIAL INCREASE IN TIN QUOTA

The main item of news at the end of last week was the publication of the International Tin Council's communiqué which increased the permissible exports of tin in the fourth quarter of this year to 30,000 tons as compared with 25,000 tons in the present quarter. At the same time the authority for the Buffer Stock Manager to operate in the price range £780-£830, was extended until the end of the year.

The London market was unmoved by the announcement as an increase in quota had been generally expected; but its size was more than most guesses which has given rise to the feeling that the Buffer Stock Manager must have sold a larger tonnage of tin than is generally estimated. The rate of export permitted is now sufficient to cover the

estimated consumption when possible tonnages of metal from other sources of supply are taken into account and it is, therefore, felt that the price level should be maintained although there may be a temporary upward jump if the steel strike in the U.S. is settled before the new quota becomes effective.

Some discussions have developed on Articles VII and XI of the agreement and these are dealt with elsewhere in this issue (page 231). The next meeting of the Council has been fixed for December 1, by which time a new draft agreement to replace the present one, which expires on June 30, 1961, will have been prepared.

On the London market there has been a slight tendency for a backwardation to appear and stocks in official warehouses at the beginning of the week showed a decrease of 424 tons at 7,829 tons.

On Thursday the Eastern price was equivalent to £813½ per ton c.i.f. London.

CONTINUED STRIKE BEGINS TO SHOW IN U.S. COPPER PRICE

The copper market remained featureless until the beginning of the week when a distinctly firmer undertone developed. This was assisted by an increase to 31½ c. per lb. in the price of copper sold by U.S. domestic producers still in

operation and for foreign copper saleable by other producers.

Although the strike situation remains unchanged, with no negotiations being currently in progress, buying has not yet developed to any abnormal extent, either in the U.S. or elsewhere. It is expected that, as the strike continues, emergency buying will begin to take place and it is almost certain that prices will be forced upwards but the majority of opinion is that this movement will not be allowed to develop by producers outside the U.S. who are believed to have some tonnages of metal in reserve to be used on such an occasion.

The London market has to some extent been based on the possibility of shipping copper to the U.S. but as buyers insist that the material must arrive well before the 30th of the month, this has now ceased and the backwardation has tended to diminish. It is understood that sales have been made in America at 33 c. per lb. and above.

The deadline is dictated by the probability of a dock strike in the U.S. beginning at the end of the month; but so far no importance has been attached to the effect this may have on shipments of copper from the U.S. to Europe under long term contracts. The tonnage coming into question is uncertain but some authorities put it as high as 20,000 tons per month from those sources of supply which are still working: should this figure prove accurate and the dock strike take place, then the combined demand for copper, on both sides of the Atlantic, may force the price up very much higher than anyone anticipates at the moment and the effects of the strike may last until the end of the year when the market will again be supported by purchasing for tax purposes.

The price in London has shown a steady increase which was helped on Monday by a reduction in stocks in official warehouses of 1,031 tons giving a total of 14,963 tons. It is expected that this figure will be substantially reduced by next week but, as explained above, the effect on the backwardation has now ceased.

ZINC STRONG, LEAD WEAK

The lead and zinc markets have once more commenced to diverge with demand for zinc remaining at a high level and the backwardation in London tending to increase, whilst demand for lead still leaves something to be desired and, with plenty of metal outside the U.S. sterling prices are expected to recede unless they are maintained by general optimism engendered by a firm copper and zinc market.

Closing prices are as follows:

	Sept. 3		Sept. 10	
	Buyers	Sellers	Buyers	Sellers
COPPER				
Cash	£235½	£236	£232½	£232½
Three months ..	£234	£234½	£232	£232½
Settlement ..	£236		£232½	
Week's turnover ..	10,275 tons		8,100 tons	
LEAD				
Current ½ month ..	£71½	£72	£71½	£71½
Three months ..	£72½	£73	£72½	£72½
Settlement ..	£73		£72½	
Week's turnover ..	5,300 tons		6,150 tons	
TIN				
Cash	£792	£792½	£793	£793½
Three months ..	£792	£792½	£792	£792½
Settlement ..	£792½		£793½	
Week's turnover ..	620 tons		520 tons	
ZINC				
Current ½ month ..	£85½	£85½	£86½	£86½
Three months ..	£84½	£84½	£85½	£85½
Settlement ..	£84½		£85½	
Week's turnover ..	4,425 tons		4,675 tons	

LONDON METAL AND ORE PRICES, SEPT. 10, 1959

METAL PRICES

Aluminium, 99.5%, £180 per ton	Iridium, £23/£25 oz. nom.
Antimony—	Lanthanum (98/99%) 15s. per gram.
English (99%) delivered, 10 cwt. and over £190 per ton	Manganese Metal (96% - 98%) £245/£250
Crude (70%) £190 per ton	Magnesium, 2s. 3d. lb.
Ore (60%) bases 19s. 6d./20s. 6d. nom. per unit, c.i.f.	Nickel, 99.5% (home trade) £600 per ton
Arsenic, £400 per ton	Osmium, £21/£23 oz. nom.
Bismuth (min. 1 ton lots) 16s. lb. nom.	Osmiridium, nom.
Cadmium 9s. 0d. lb.	Palladium, £6 10s./£7 10s.
Cerium (99%) net, £16 0s. lb. delivered U.K.	Platinum U.K. and Empire Refined £28 10s. oz.
Chromium, Cr. 99% 6s. 11d./7s. 4d. lb.	Imported £26½/£27½
Cobalt, 14s. lb.	Quicksilver, £72 ex-warehouse
Germanium, 99.99%, Ge. kilo lots 2s. 5d. per gram,	Rhodium, £41/£45 oz.
Gold, 250s. 7½d.	Ruthenium, £18/£20 oz. nom.
	Selenium, 50s. 0d. per lb.
	Silver, 78½d. f. oz. spot and 78½d. f'd
	Tellurium, 18s. lb.

ORES AND OXIDES

Bismuth	65% 8s. 6d. lb. c.i.f.
Chrome Ore—	18/20% 1s. 3d. lb. c.i.f.
Rhodesian Metallurgical (semifriable) 48% (Ratio 3:1)	£15 15s. 0d. per ton c.i.f.
Hard Lump 45% (Ratio 3:1)	£15 10s. 0d. per ton c.i.f.
Refractory 40% (Ratio 3:1)	£11 0s. 0d. per ton c.i.f.
Small 44% (Ratio 3:1)	£14 0s. 0d. per ton c.i.f.
Baluchistan 48% (Ratio 3:1)	£11 15s. 0d. per ton f.o.b. nom.
Columbite, 65% combined oxides, high grade	
Fluorapatite—	
Acid Grade, Flotated Material	£22 13s. 3d. per ton ex. works
Metallurgical (75/80% CaF ₂)	156s. 0d. ex works
Lithium Ore—	
Petalite min. 3½% Li ₂ O	40s. 0d./45s. 0d. per unit f.o.b. Beira
Lepidolite min. 3½% Li ₂ O	40s. 0d./45s. 0d. per unit f.o.b. Beira
Amblygonite basis 7% Li ₂ O	£25 0s. per ton f.o.b. Beira
Magnetite, ground calcined	£28 0s./£30 0s. d/d
Magnetite Raw (ground)	£21 0s./£23 0s. d/d
Manganese Ore Indian—	
Europe (46% - 48%) basis 57s. 6d. freight	nom.
Manganese Ore (43% - 45%)	nom.
Manganese Ore (38% - 40%)	nom.
Molybdenite (85%) basis	8s. 11d. per lb. (f.o.b.)
Titanium Ore—	
Rutile 95/97% TiO ₂ (prompt delivery)	£29/£30 per ton c.i.f. Aust'n.
Ilmenite 52/54% TiO ₂	£11 10s. per ton c.i.f. Malayan
Wolfram and Scheelite (65%)	160s. 0d./167s. 6d. per unit c.i.f.
Vanadium—	
Fused oxide 95% V ₂ O ₅	8s./8s. 11d. per lb. V ₂ O ₅ c.i.f.
Zircon Sand (Australian) 65 - 66% ZrO ₂	£16/£17 ton c.i.f.

Mining Finance

Roan's Splendid Recovery

The table below summarizes the reports of the companies of the R.S.T. group for the period April-June, the last quarter of the financial year for all three companies. It will be seen that the final picture is very similar to that forecast by the R.S.T. chairman at the informal meetings held in London and New York seven months ago.

Certainly the results must be counted satisfactory. At Roan, the total production of 80,872 tons compares with a "pre-strike" target of 80,000 tons, and exceeds Sir Ronald's estimate by some 3,300 tons. This has enabled stocks to regain the level existing at the end of the 1958 financial year, and quite obviously represents extremely high pressure operations in the second half of the financial year. Mufulira's recovery was not quite so spectacular, largely because of a slight slackening of tempo in the June three months, but total production was nevertheless 2,500 tons above Sir Ronald's forecast.

Noteworthy also is the successful attack on costs made by the two companies. The point here is that only about 65 per cent of total operating and administration costs are under the control of the mine management, the rest comprising such items as transport and copper royalty. Many of the constituents of this latter group are linked

directly or indirectly to the copper price. Thus the improvement in price experienced by Roan and Mufulira in the past financial year would have cost some £6 per ton in additional royalty alone. Yet Mufulira's operating and selling costs rose by no more than £7, and Roan's by £3, this including the strike-bound quarter when Mufulira's expenditure averaged more than £155 per ton.

	Sales (000 tons)	Profit (£000)	Cost per ton (£)
Roan Antelope:			
June '59 qtr. ...	21.3	1,549	145
1957-8 ...	77.4	2,322	144
1958-9 ...	80.6	4,891	147
Mufulira:			
June '59 qtr. ...	21.6	1,879	141
1957-8 ...	88.8	4,150	138
1958-9 ...	87.5	6,574	144
Chibuluma:			
June '59 qtr. ...	6.5	471	139
1957-8 ...	27.2	1,152	108
1958-9 ...	19.1	1,031	143

In view of these achievements in the fields of costs and production, it is not surprising that the financial out-turn is at least equally satisfactory. At £4,891,000 before tax but after depreciation, Roan's estimated profits are more than double those for 1957-8, in spite of a more than four-fold increase in the net amount provisionally set aside for

replacements and obsolescence. Mufulira's improvement from £4,150,000 to £6,574,000 is less marked, but still represents a rise of more than 50 per cent, no mean achievement in a year not notable for peaceful labour relations.

TRONOH AND S. TRONOH PRELIMINARY RESULTS

Shareholders of Southern Tronoh Tin Dredging and Tronoh Mines should look on their managements with some gratitude. The preliminary results from these companies for 1958 are at least as bad as was to be expected in view of the difficulties experienced that year. Compared with the bumper 1957 profits, earnings were very sharply lower, but dividends have by no means been reduced in proportion, and both companies are, in fact, distributing fractionally more than their net profit after tax.

Southern Tronoh earned £23,625 (against £167,629) and is distributing a final 3d. making a total of 20 per cent at a cost of £23,750. Last year 50 per cent was paid. Similarly, Tronoh's total payment of 43½ per cent, which includes a final of 4d., absorbs £257,917 against earnings of £256,134. This compares with a distribution of 60 per cent from earnings of £761,966 for 1957.

The overdistributions obviously stem from the strong liquid balances built up in earlier years, and must be taken to indicate that earnings are now recovering well as a result of quota relaxations and of higher revenue per ton. Indeed, although the recent year started with permitted production below that for 1958, by the end of the year total output should have exceeded last year's by some 6 per cent. Southern Tronoh, it will be remembered, made an arrangement in July, 1958, whereby its own dredges were laid up and its quota filled by Tronoh.

LONDON MARKET HIGHLIGHTS

Understandably enough, interest on the London Stock Exchange this week was far too pre-occupied with "election stocks" to pay much attention to the gold share market. The steel share section provided a much more attractive field than did Kaffirs for the speculators, and although genuine investors appreciated the election hedging possibilities of Kaffirs, their inquiries were followed by little actual business. To make matters worse on Monday, both the Cape and New York markets were closed.

Business began to pick up again on Wednesday, however, and a fair scattering of price gains was seen. Among them, West Driefontein suddenly came to life with a jump of 3s. 9d. to 163s. 9d.; the move followed talk of good gold values being found in development from the new deep-level shaft. In sympathy, Western Deep put on 1s. to 46s. 9d. "Writs" remained firm at 62s. 9d., still being influenced by a suggested switch into the shares from the lower yielding West Wits (71s. 6d.). News of the quadrupled dividend from Lydenburg Estates lifted the shares momentarily to 18s. 6d., but profit-taking soon left them 3d. off on balance at 17s. 9d.

The imminence of the Anglo American group half-yearly O.F.S. dividends failed to stimulate much interest. Free State Geduld (183s. 1½d.) continued to drift back and a certain amount of cutting of professional commitments was suspected.

Main feature of the Diamond group was provided by a sudden jump of

3s. 1½d. to 173s. 9d. in De Beers inspired by Cape optimism in front of the interim dividend. Platins were little affected by an improvement in the market for their metal.

The strength of the copper price was only partly reflected in shares of the producers. Although being reportedly "as steady as a rock", the share market's immobility was equally massive. The encouraging June quarterly reports from Rhodesian Selection Trust and Roan Antelope were generally considered to be in line with expectations and did little more than cause Roan to harden a few pence to 8s. Nchanga were quoted at £12 15s., on Tuesday the shares will be quoted ex the three-for-one scrip issue. The effect of this will be to divide the price by one-quarter and Nchanga, at a manageable 64s. or so, may well become a much livelier counter.

Tins fell into some profit-taking after their recent rise, the increase in export quotas announced for the final quarter of 1959 having been largely discounted in share prices. Tronoh (16s.) resisted the dullness later when the final dividend and bonus were announced. There was also a subsequent rise in Beral to 33s. 9d.; this hardly kept pace with the rise in wolfram which in three days spurred 41s. 3d. to 163s. 9d. a unit.

Lead-zincs fluctuated rather indecisively with Consolidated Zinc a persistently dull spot at 63s. Elsewhere, further talk of Japanese antimony purchases from Consolidated Murchison raised the share price to 48s. 9d.

CAN-ERIN STILL FINDING ORE

A report from Can-Erin Mines, the Canadian-controlled company re-developing the old Mountain Mine in County Cork, states that drilling and drifting at depth is continuing to prove sizeable tonnages of good grade copper ore.

The most important aspect of the latest discoveries are the indications that high-grade ore persists to considerable depths. Drilling from the 1,350 level has cut good widths and values approximately 200 ft. deeper than any previous development in the mine.

Another encouraging pointer to prospects is that it is now proved beyond doubt that the earlier operators of the mine had ceased mining only because the limits of their equipment had been reached. Channel samples taken across the footwall of the old stope on the North-South orebody have assayed from 2.55 per cent over 7 ft. up to 16.15 per cent over 6 ft.

LYDENBURG AND THE TAX-MAN

Lydenburg Estates, one of the smaller finance companies of the Anglo American group, came into prominence this week with the news that its dividend was to be quadrupled.

Lydenburg's prosperity derives almost entirely from its shareholdings in Welkom, President Brand and President



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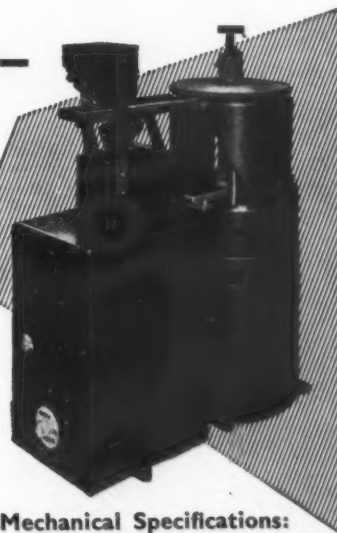
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Steyn, and dividends from these sources were unchanged in the past financial year. The £2,500 improvement in earnings before tax (£42,060, against £39,578) probably resulted from some slight alteration in the shareholdings, or possibly an improvement in the royalty received from the lease of a small asbestos proposition.

For the increased dividend—1s. against 3d. — however, thanks are due to the Inland Revenue, who will be making do on £14,533 against £25,838 last year. The major reason for this is that President Brand is now paying full tax, much of which is reclaimable by an English company (or shareholder) paying a sufficient rate. This means that last year's 5s. from Brand was worth considerably more to Lydenburg than the similar distribution a year before, when Brand was still amortizing capital expenditure. The same factor will apply to President Steyn and Welkom when they become liable for tax, paying the way for higher dividends from firms like Lydenburg than is sometimes realized.

Financial News and Results

Exploration Company Earns More.—In the year ended December 31, 1959, The Exploration Company earned £63,898 after tax, exclusive of investment appreciation. This represents an improvement from £36,580 in 1958. Meeting, September 25 at Exploration House.

Morning Star.—Net profit of Morning Star Gold Mines in the year to March 31, 1959, amounted to £A26,600. This compares with a net loss in the preceding year of £40,400. Ore reserves at the end of the year were estimated at 8,000 tons at an average value of 6.5 dwt., compared with 6,000 tons at 10.0 dwt. a year earlier. Meeting, Melbourne, September 16.

Billiton Profits Lower.—The Billiton Tin Company experienced a reduction in consolidated net profits from F1.5,700,000 to F1.3,200,000 in 1958.

Goldfield's E.G.M.—At the extraordinary meeting of Consolidated Gold Fields held last Monday, a resolution was passed increasing the capital of the company from £11,000,000 to £14,000,000. The additional capital will be needed to cover acceptances of Gold Fields' bids for New Union Goldfields and H.E. Proprietary.

Pusing to Pay More.—Although profits after all charges fell to £5,220 from £5,864 in the year ended February 28 last, Pusing Rubber and Tin is recommending a dividend of 15 per cent, compared with 10 per cent for 1957-58. Meeting, October 15.

Ballot for Excess Bisichi Shares.—The recent rights issue by Bisichi Tin of 778,025 shares at 3s. per share was heavily oversubscribed, applications for "excess" shares totalling more than 1,250,000. The excess shares will, therefore, be allotted by ballot.

Kalgoorlie Electric Doubles Profits.—After all charges, Kalgoorlie Electric Power earned a profit of £35,602 in the year to December 31, 1958. This compares with £15,003 in 1957. The profit has been transferred to reserve in its entirety, leaving the loss to be carried forward unchanged at £27,627. Meeting, October 2.

Rand and Orange Free State Returns for August

GOLD OUTPUT AND PROFIT

Company	August 1959			Year ends	Current Financial Year			Last Financial Year		
	Tons (000)	Yield (oz.)	Profit† (£000)		Tons (000)	Yield (oz.)	Profit† (£000)	Tons (000)	Yield (oz.)	Profit† (£000)
Gold Fields										
Doornfontein	95	38,580	190.9	J	189	76,682	377.4	174	72,916	387.1
Libanon	110	25,709	60.2	J	217	50,824	118.8	196	45,954	109.5
Luipaards Vlei	73	12,782	5.6	J	146	25,543	11.5	140	24,271	10.2
Rietfontein	16	4,308	8.4	D	128	33,764	59.2	176	40,020	103.1
Robinson	53	11,077	L 1.8	D	470	99,573	L70.8	578	123,445	40.2
Simmer & Jack	83	16,376	3.1	D	693	130,790	L48.4	698	133,766	113.6
Sub Nigel	66	15,824	22.2	J	132	31,659	44.9	132	32,109	52.9
Venterspost	128	32,154	61.8	J	259	64,431	123.1	261	64,413	121.2
Vlakfontein	52	18,564	87.6	D	403	144,817	684.1	396	139,738	677.1
Vogels	90	20,053	31.7	D	736	155,165	298.8	765	171,391	350.9
West Drie	99	90,688	752.1	J	196	179,230	1484.9	160	152,636	1249.4
Anglo American										
Brakpan	143	17,180	12.9	D	1,107	133,945	89.5	994	132,481	98.4
Daggas	244	48,479	230.1	D	1,919	387,051	1899.5	1,848	384,645	2011.0
East Daggas	103	17,436	37.6	D	796	132,876	258.5	729	120,878	225.6
F.S. Geduld	91	74,288	570.7	S	879	683,318	5070.4	729	522,294	3609.9
President Brand	120	98,166	869.9	S	1,147	894,956	7796.4	891	664,340	3398.0
President Steyn	104	41,221	203.0	S	1,086	421,923	2126.9	1,046	413,557	2236.6
S.A. Lands	100	20,755	58.1	S	772	161,438	456.4	713	155,949	419.3
Springs	104	14,333	15.1	D	831	113,774	99.8	1,014	113,850	68.6
Vaal Reefs	95	42,750	220.9	D	698	315,437	1663.9	569	256,289	1449.3
Welkom	100	31,170	82.7	S	1,049	320,871	872.7	938	277,378	771.6
Western Holdings	136	84,320	663.5	S	1,250	752,792	5774.8	1,069	758,151	4974.6
West. Reefs Ex.	139	36,765	115.3	D	1,027	268,619	793.5	895	210,730	501.3
Central Mining										
Blyvoor	131	84,495	633.2	J	266	170,230	1274.7	211	134,825	970.9
City Deep	120	24,642	9.0	D	925	192,630	79.6	1,057	206,361	78.3
Cons. M.R.	104	18,630	8.2	J	214	38,627	17.4	265	41,879	26.2
Crown	224	35,234	17.8	D	1,771	280,573	98.5	1,839	279,598	124.5
D. Roodepoort	200	36,556	55.2	D	1,522	281,569	428.9	1,450	262,171	406.4
East Rand Prop.	227	59,722	123.1	D	1,781	460,966	971.6	1,687	453,812	1185.7
Harmony	140	54,964	251.3	J	287	113,040	521.6	177	69,527	258.2
Modder East	139	13,663	2.9	J	289	27,528	6.2	282	27,134	3.5
Rose Deep	31	5,111	L1.3	D	319	42,174	0.4	455	59,301	24.6
J.C.I.*										
Freddies Cons.	60	14,486	L37.4	D	469	113,224	L296.9	417	121,268	L305.9
Govt. G.M.A.	53	10,622	0.6	D	428	85,458	L13.5	499	88,310	8.0
Randfontein	41	6,918	10.1	D	285	49,403	73.8	230	36,504	40.6
Union Corporation										
East Geduld	143	42,186	286.2	D	1,102	331,077	2226.9	1,020	313,675	2139.7
Geduld Prop.	75	14,364	37.8	D	582	109,403	209.0	632	102,268	77.1
Grootvlei	225	47,269	252.5	D	1,680	355,429	1819.7	1,570	334,294	1702.0
Marievale	98	23,706	121.0	D	750	184,965	902.4	569	149,313	660.5
St. Helena	160	50,002	288.5	D	1,190	359,726	1950.6	940	276,011	1380.0
Van Dyk	73	14,014	29.3	D	605	113,948	214.8	609	112,055	202.4
Winkelhaak	80	21,003	59.0	D	597	147,864	301.5	—	—	—
General Mining										
Buffelsfontein	144	54,755	284.2	J	288	109,276	568.6	235	79,056	366.0
Ellaton	32	7,241	28.2	D	251	58,254	234.9	256	59,426	252.7
S. Roodepoort	29	7,072	22.1	J	60	14,367	45.7	60	14,227	49.3
Stilfontein	150	69,934	400.0	D	1,115	543,174	3288.8	899	444,191	2862.6
W. Rand Cons.	145	20,850	22.3	D	1,097	159,293	151.9	1,123	146,543	118.7
Anglo Transvaal										
Hartebeestfontein	91	48,685	316.3	J	179	95,205	628.5	174	94,830	627.6
Loraine	82	16,031	L19.1	S	846	165,097	L209.0	741	140,362	L212.7
N. Klerksdorp	10	1,111	L8.7	D	82	8,809	L71.8	81	8,682	L63.2
Rand Leases	196	28,910	31.2	J	394	57,917	58.1	354	51,948	17.3
Village M.R.	28	4,731	1.2	J	56	9,357	2.2	56	9,516	4.0
Virginia O.F.S.	134	30,987	11.9	J	268	62,142	25.2	213	55,545	90.7
Others										
N. Kleinfontein	83	10,786	3.2	D	662	85,873	24.8	710	85,438	L30.2
Wit Nigel	18	4,376	5.1	J	36	8,761	10.2	36	8,778	13.6

Gold has been valued at 249s. 4d. (July 249s. 4d.) per oz. fine. L indicates loss. †Working Profit. *Working Profit includes sundry revenue. Table excludes profits from Uranium, Pyrite and Acid, and also production from Uranium divisions at Luipaards Vlei, Randfontein and W. Rand Consolidated.

ESTIMATED URANIUM REVENUE

Company	Year ends	Aug. Profit (£000)	This year (cum.) (£000)	Last year (cum.) (£000)	Company	Year ends	Aug. Profit (£000)	This year (cum.) (£000)	Last year (cum.) (£000)
Gold Fields					J.C.I.				
Doornfontein	J	14.0	28.0	30.0	E. Champ d'Or (b)	D	7.1*	54.2*	48.3*
Luipaards Vlei (a)	J	93.0	185.0	178.0	Freddies Cons.	D	37.0*	278.0*	223.0*
Vogels	D	54.0	417.0	427.0	Govt. G.M.A.	D	22.0*	176.4*	194.1*
West Drie	J	50.0	100.0	92.0	Randfontein (a)	D	105.1*	847.8*	881.5*
Anglo American					General Mining				
Daggas	D	134.0	1101.5	1121.0	Buffelsfontein	J	213.0	426.0	375.0
President Brand	S	45.2	503.9	468.0	Ellaton	D	16.0	145.0	127.0
President Steyn	S	58.9	657.9	624.0	Stilfontein	D	83.0	685.0	724.0
Vaal Reefs	D	144.1	1132.8	1042.0	W. Rand Cons. (a)	D	202.9	1601.7	1814.6
Welkom	S	56.5	625.3	586.0	Anglo Transvaal				
West. Reefs Ex.	D	161.6	1269.4	1220.0	Hartebeestfontein	J	264.0	531.6	535.5
Central Mining					Loraine	S	35.0	380.0	357.0
Blyvoor	J	150.0	303.4	328.8	N. Klerksdorp	D	11.0	87.5	96.0
Harmony	J	195.2	401.2	248.8	Virginia O.F.S.	J	175.5	352.7	370.7

Table includes profit from uranium, acid and pyrite before loan redemption. (a) Total profit from uranium section. (b) Overall profit. *Net revenue after provision for loan redemption.

1959

st

Year
e
Profit†
(£000)

387.1
109.5
10.2
103.1
40.2
113.6
52.9
121.2
677.1
350.9
1249.4

98.4
2011.0
225.6
3609.9
5398.0
2236.6
419.3
68.6
1449.3
771.6
4974.6
501.3

970.9
78.3
26.2
124.5
406.4
1185.7
258.2
3.5
24.6

L305.9
8.0
40.6

2139.7
77.1
1702.0
660.5
1380.0
202.4
—

366.0
252.7
49.3
2862.6
118.7

627.6
L212.7
L63.2
17.3
4.0
90.7

L30.2
13.6

Working
duction

Last
year
(cum.)
(£000)

48.3*
223.0*
194.1*
881.5*

375.0
127.0
724.0
814.6

535.5
357.0
96.0
370.7

ranium